[LETTERHEAD]

VIA ELECTRONIC SUBMISSION AND MAIL

Jeanine Townsend
Clerk to the Board
State Water Resources Control Board
P.O. Box 100
Sacramento, California 95812

RE: Bay-Delta Workshop 2: Fishery Resources -- Pelagic Fishes and Salmonids

Dear Ms. Townsend:

EPA is providing comments in response to the State Water Resources Control Board's ("Board's") notice dated June 22, 2012, in which the Board presented the schedule for a series of workshops on particular topics associated with its review and potential revision of the 2006 Water Quality Control Plan (WQCP) for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan). This letter responds to questions in the Board's aforementioned notice for the second workshop, Bay-Delta Fishery Resources Focused on Pelagic Fishes and Salmonids, and addresses some of the information submitted by stakeholders for the September 5th and 6th 2012 State Board Workshop. Our comments build on previous EPA input on the Board's review of the Bay-Delta Plan (see letters of August 17, 2012, April 24, 2012; February 9, 2012; and March 19, 2009).[1]

What additional scientific information should the State Water Board consider to inform potential changes to the Bay-Delta Plan relating to Bay-Delta fishery resources, and specifically to pelagic fishes and salmonids, that was not addressed in the 2009 Staff Report and the 2010 Delta Flow Criteria Report?

1. ***Aquatic life beneficial uses are not adequately protected by CWA programs and the State Water Board update of the 2006 Bay-Delta Water Quality Control Plan is EPA's top priority restoring protection for aquatic life beneficial uses.***

The U.S. Environmental Protection Agency (EPA) released an Action Plan for addressing water quality challenges in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay Delta Estuary) on August 28, 2012. The action plan summarizes an EPA assessment of aquatic life beneficial use protection by CWA programs and identifies priority actions for restoring protection for all beneficial uses adopted in the 2006 WQCP. The EPA assessment concludes that rapidly declining fish populations are compelling evidence that Clean Water Act (CWA) programs are not adequately protecting aquatic resources of the Bay Delta Estuary and its tributary watersheds.
The Action Plan identifies updating SF Bay Delta flow standards as the number one priority

[1] Available at www.epa.gov/sfbaydelta/activities

for restoring aquatic life habitat in the Bay Delta ecosystem. Other priorities outlined in the Action Plan include:

- Advance regional water quality monitoring and assessment programs
- Accelerate water quality restoration through Total Maximum Daily Loads
- Strengthen selenium water quality criteria
- Prevent pesticide pollution
- Restore aquatic habitats while managing methylmercury
- Support the Bay Delta Conservation Plan

Collectively, these activities will contribute to the restoration of the Bay Delta Estuary. Even if they are all successfully implemented, however, they are not sufficient to resolve the multifaceted problems that have stressed the ecosystem to the point of collapse. Any solution to the complex ecological problems of the Bay Delta Estuary must be multi-faceted, including providing sufficient flows, physical habitat which is sufficiently large, connected, diverse, and self-sustaining, as well as a reduction of many types of stressors, such as contaminants, invasive species, and predation

The Action Plan and supporting documents are available at www.epa.gov/sfbaydelta/actionplan.

2. ***Altered Delta outflow and salinity conditions are two primary stressors driving ecosystem changes in the Delta***

Recent analyses have identified drivers associated with long-term trends in POD fishes.[2] Most of these drivers changed gradually before the POD and are listed as follows in a hypothesized order of importance: (1) outflow, (2) salinity, (3) landscape, (4) temperature, (5) turbidity, (6) nutrients, (7) contaminants, and (8) harvest.[3]

Observed changes in abiotic variables (drivers) have lead to a profound change in biological populations and communities. The Bay Delta ecosystem is shifting away from a dynamic estuarine ecosystem that supports diatom algal communities, copepods, mysid shrimp, and plankton-feeding fish (delta smelt, longfin smelt, and juvenile striped bass) to a more static aquatic ecosystem that supports toxic algae, jellyfish, clams, aquatic weeds and fish that can tolerate these conditions. This change is associated with the POD.[4] Community shifts are rapid, large-scale, lasting changes in ecosystems from one more-or-less stable community to another[5] caused by a non-linear system response to drivers of change.

3. Historical salinity patterns in the delta

[2] Thomson et al. 2010

[3] Baxter, R et a. Interagency Ecological Program 2010 Pelagic Organism Decline Work Plan and Synthesis of Results. Page 89-91.

[4] Manly and Chotkowski 2006, Moyle and Bennett 2008, Mac Nally et al. 2010, Thomson et al. 2010, Moyle et al. 2010.

[5] Scheffer and Carpenter 2003

Salinity distributions in the estuary have changed substantially through time. In their exceptional new study of the historical ecology of the delta Whipple and Grossinger (August 2012) collate a wealth of historical observations on the nature of the estuary. Most historical descriptions portray the delta as predominantly freshwater with rare incursions of salt water into the western delta. One representative quote from 1879 says "The water along the San Joaquin frontage is fresh for ten months out of the twelve, and, in most years, is fresh the entire year; even in very dry seasons it is fresh at low water." (Smith and Elliot.)

In the early 20th century upstream consumptive use and channel deepening in the delta led to substantial salinity intrusion (and tremendous impacts of the invasive shipworm Toredo (Rickets and Calvin 1984) Ricketts, E.F. and J. Calvin 5th edition 1984, Stanford University Press).

Salinity distributions indexed by X2 can be calculated from the DAYFLOW database of DWR using the daily and monthly X2 models of Jassby (SFEI 1992). Dr Anke Mueller-Solger, the lead scientist for the Interagency Ecological Program, has presented the estimated salinity regime under unimpaired flows and under six historical periods since 1930. Her graphs tell an interesting and relevant history of the delta 'halograph.'

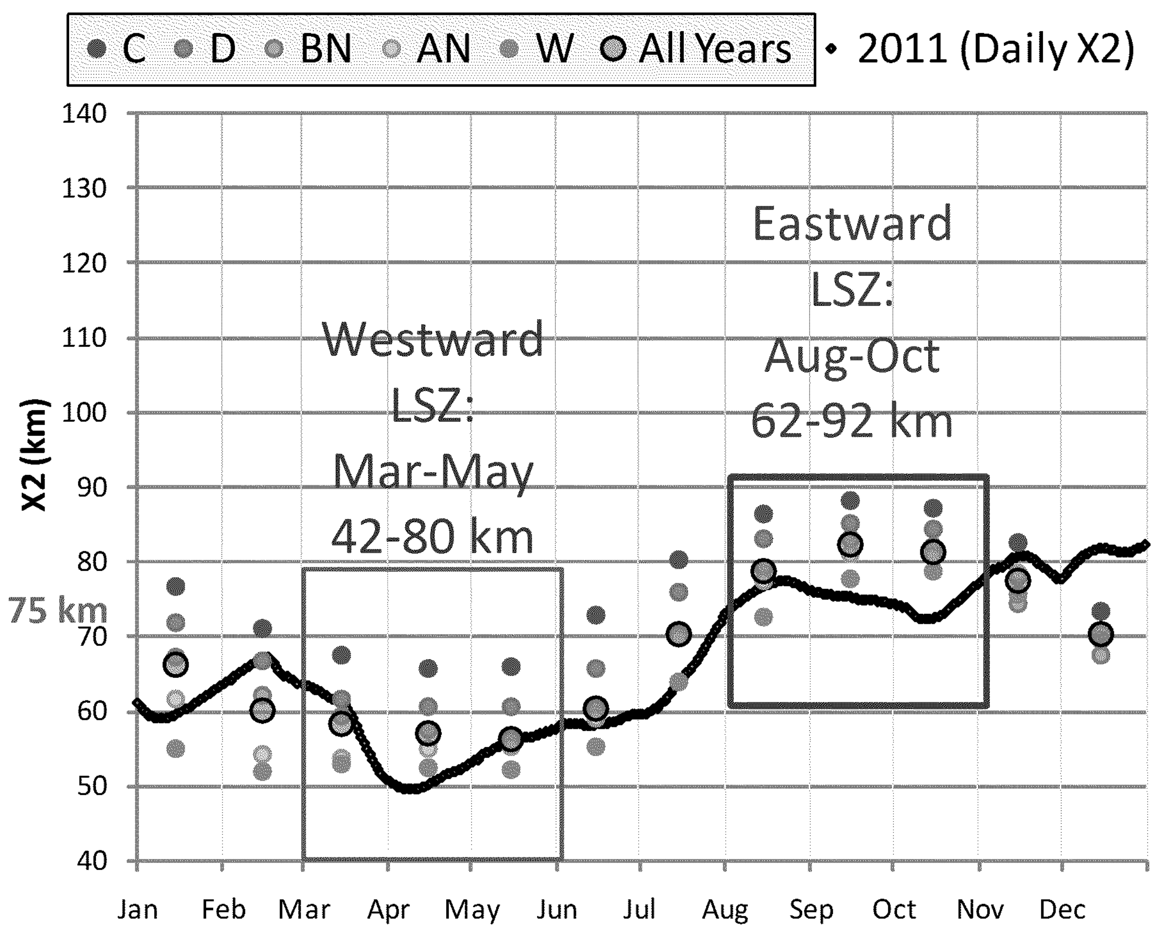


Figure 1. Monthly **Median Unimpaired X2** (km), January-December 1921-2003.

(Calculated from Unimpaired Average Monthly Net Delta Outflow (DWR) Using Jassby et al. 1995 Monthly Equation

As the Board knows, unimpaired flows are an estimate of how precipitation and runoff would pass through the estuary with its current configuration of leveed and deepened channels. Thus, unimpaired flows do not yield the almost constant freshwater delta described by Whipple and Grossinger 2012 (and their historical references). However, the unimpaired flows show a basic 'halograph' that varies seasonally in all year types with wetter years having reliably lower X2 values than dry years.

Calculated annual halographs for six time periods show the impact of California's water management actions. Figure 2. Shows extreme salinity intrusions in dry seasons of dry years, due to consumptive use and the leveeing and deepening of channels throughout the Central Valley. Figures 3 & 4 show something like the unimpaired delta halograph as Shasta, Friant and Oroville were managed to reduce flooding in the spring and salinity intrusion in the summer and fall. Figures 5 & 6 document an increasing trend toward reduced seasonal variability in drier years and an increase in X2 values above the reference range of salinities calculated from the unimpaired flows and from X2 of the post dam period shown in figures 3 & 4.

Finally, figure 7 suggests that the Board's previous decision in D-1641 restored the range of variability in spring months expected from unimpaired flows and limited the upper range of salinity intrusion in fall months. However, fall X2 values no longer show the variability that they had in figures 5 & 6 (i.e. 1968-1999); irrespective of year type the fall X2 values are greater than 75 in all but 2011.

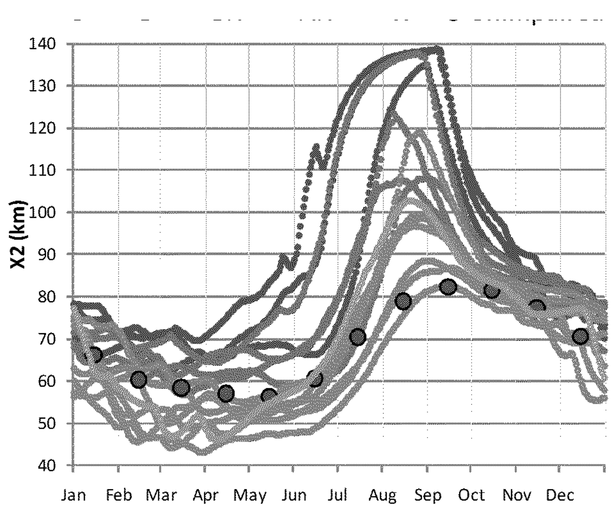


Figure 2. Daily X2 Before major dam construction (1930-1944). Note extreme salinity intrusion in summer and fall of drier years. Red = Critical, orange = Dry, yellow = Below normal, cyan = Above normal, blue = Wet. Black dots are monthly mean calculated from unimpaired.

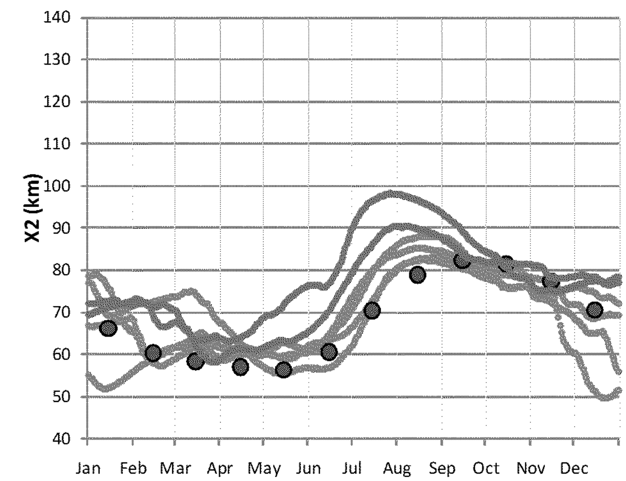


Figure 3. Daily X2 Before CVP exports began (1945-1950). Red = Critical, orange = Dry, yellow = Below normal, cyan = Above normal, blue = Wet. Black dots are monthly mean calculated from unimpaired.

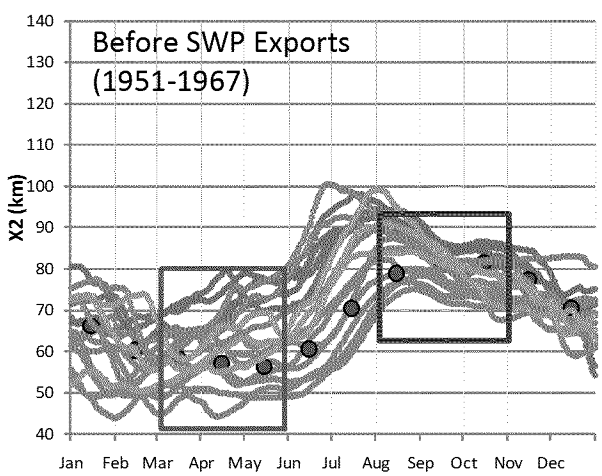


Figure 4. Daily X2 Before SWP exports began (1951-1967). Red = Critical, orange = Dry, yellow = Below normal, cyan = Above normal, blue = Wet. Black dots are monthly mean calculated from unimpaired, boxes cover unimpaired range.

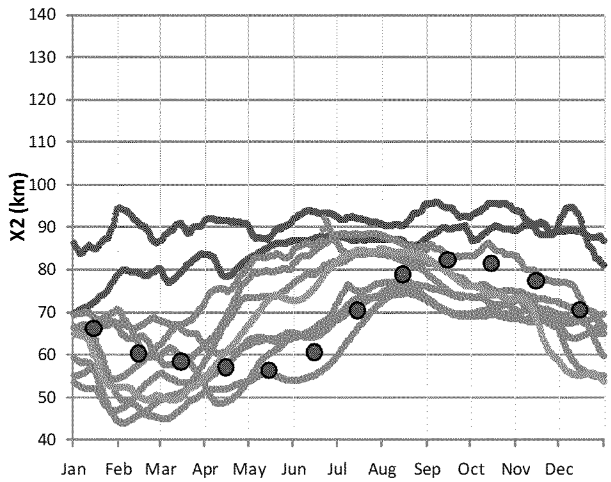


Figure 5. Daily X2 After SWP and D-1379 (1968-1977). Red = Critical, orange = Dry, yellow = Below normal, cyan = Above normal, blue = Wet. Black dots are monthly mean calculated from unimpaired.

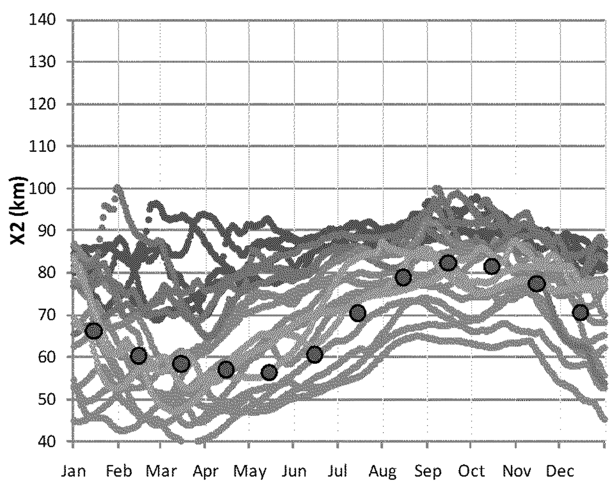


Figure 6. Daily X2 After D-1485 (1978-1999). Red = Critical, orange = Dry, yellow = Below normal, cyan = Above normal, blue = Wet. Black dots are monthly mean calculated from unimpaired.

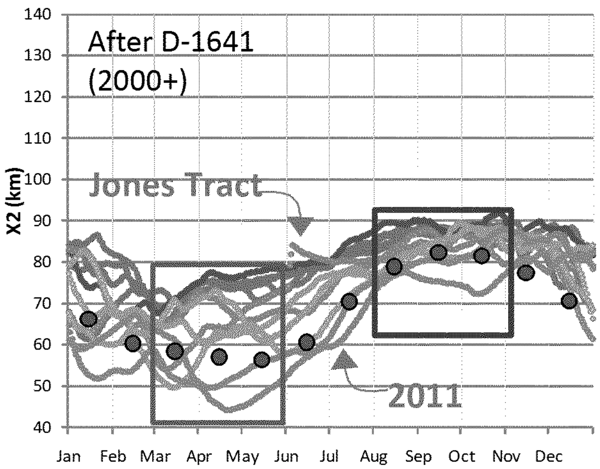
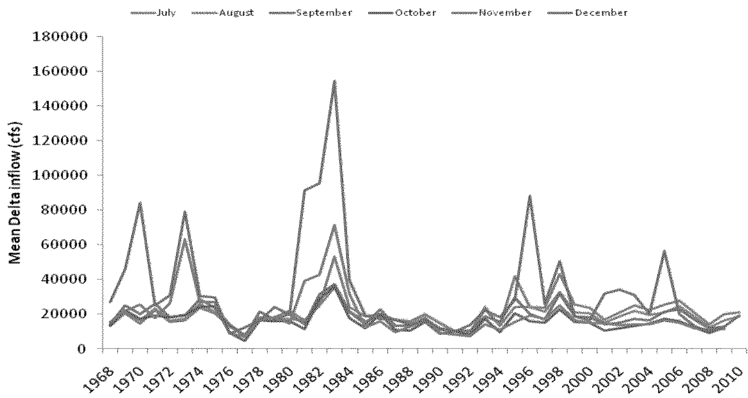


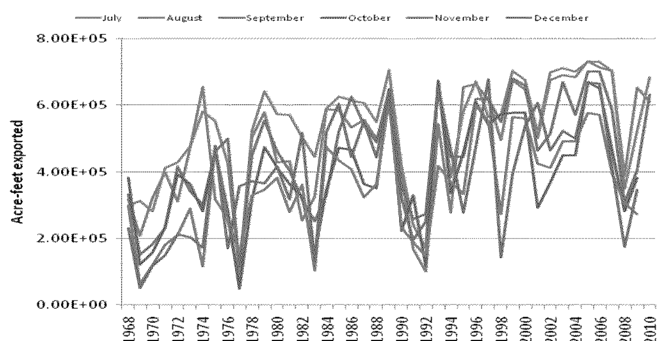
Figure 7. Daily X2 After D-1641 (2000- 2011). Red = Critical, orange = Dry, yellow = Below normal, cyan = Above normal, blue = Wet. Black dots are monthly mean calculated from unimpaired.

4. CVP and SWP exports are drivers of ecosystem changes that have substantially increased since the year 2000.

CVP and SWP exports are drivers of Delta outflow, salinity, and turbidity that have changed considerably since the year 2000 as the POD began. Inflows to the Delta have not changed much over the last X years, see figure ?. However, CVP and SWP exports have consistently increased and reached historical maximum export volumes in 2006 and 2011, see figure Y. Subsequently, Delta outflow has been low from July to January, the months not covered by the Delta Outflow Objective in the 2006 WQCP, in all but one year from 2000 to the present (2012), the LSZ has moved eastward, and population abundance of several pelagic fishes has gone down as predicted by X2-abundance correlations.

[I would love to show this as a histogram instead of the line chart from Matt N's slides at the last workshop. I don't have anything else to place here. It would also be cleaner to look at annual total exported instead of the monthly charts. Any idea how I can build those charts? I recall Tina Swanson's ppt at the SoE Conf. in 2011 saying that inflows HAVE gone down. Look at her slides here http://www.sfestuary.org/soe2011/soe_videos.html, third link from the top.]





Can we say anything about the relative change in other stressors? Ammonia? Pesticides? Growing population & Stockton vs Sac.. shift in types of pesticides

5. ***Restoring protection for aquatic life beneficial uses requires minimizing the impacts of multiple stressors including flows.***

The State and Regional Water Boards are actively addressing multiple stressors that negatively impact aquatic life and other beneficial uses in the Bay Delta Estuary. Information presented at Workshop 1 (Ecosystem Changes and the Low Salinity Zone, September 5-6, 2012), in written comments for Workshop 1, and in other communications, describes a number of different stressors that contribute to the POD and inadequate support for aquatic life beneficial uses. EPA agrees with the conclusion that the POD is the result of multiple stressors working together to degrade aquatic life habitat and result in dramatic fish population losses. We list below the actions the Water Boards have taken to address these other stressors below and note that the State Board has not modified flow objectives for more than 17 years.

- The Central Valley Regional Water Board studied the potential effects of ammonia on aquatic species and issued a new discharge permit to the Sacramento Regional County Sanitation District wastewater treatment facility, the largest known point source of ammonia to the Bay Delta Estuary, requiring advanced treatment.
- Delta Methylmercury TMDL was adopted and implementation is under way;
- Key steps were taken toward developing a Delta Regional Monitoring Program (RMP), including publishing the first Pulse of the Delta report
- New flow objectives to support migratory fish populations for the San Joaquin River and tributaries were proposed and are slated for adoption in 2013
- Water quality improvements were made through implementing TMDLs for selenium, organophosphate pesticides, and low dissolved oxygen (see Table 1).

CVP, SWP, and other water diversions are a manageable part of this system and can be used to contribute to the restoration of protection for all beneficial uses. Information presented at Workshop 1 (Ecosystem Changes and the Low Salinity Zone, September 5-6, 2012) suggested that broad climatic variations are responsible for the largest portion of variability in precipitation (water availability) observed in the Bay Delta Estuary watershed. These results appear to be reasonable[6] however their use is limited because the SWRCB cannot control or manage climactic variability. The SWRCB can control and manage diversions of water from the Bay Delta Estuary watershed. CVP and SWP exports (diversions) have substantially increased over the last decade almost regardless of climactic variability in precipitation (water availability in the watershed). It is reasonable and necessary for the SWRCB to address primary, manageable stressors that are negatively affecting aquatic life beneficial uses in the Bay Delta Estuary. This includes updating WQCP to include objectives that may limit diversions to increase protection for aquatic habitat.

It is time for the State Board to address flows by updating the WQCP. This process began in 2009 with Phase I addressing San Joaquin River flows. The State Board has identified a range for new flow objectives to support migratory fish populations in the San Joaquin River and its tributaries. This process is anticipated to be complete in 2013. Restoring protection for aquatic life beneficial uses requires multiple actions addressing multiple stressors. The Water Boards are actively addressing many other stressors. Identifying appropriate freshwater flows is a necessary part of addressing other stressors and restoring protection for impaired beneficial uses.

6. Delta outflow could be increased without disrupting the operations of reservoirs on Delta tributaries

When inflow from Delta tributaries is compared with Delta outflow in the period since 2000[?], the data reveal that inflow during the fall has not changed substantially, but outflow

[6] EPA has not reviewed the technical work that produced these results.

during the fall has been drastically decreased so that fresh water otherwise flowing into the Delta from the upstream reservoirs and tributaries can be diverted from the South Delta and exported to water storage facilities in Kern and Riverside counties. The State Water Board could increase Delta outflow without disrupting the operation of the reservoirs, and therefore preserve the cold pool of water that is so critical to the recovery of salmonids. The State Water Board could focus on how to best balance the needs of fishery resources within the Delta with the consumptive uses of agricultural and municipal stakeholders who operate the water storage facilities.

Increases in Delta outflow should be linked with, and expressed by, the achievement of salinity standards (e.g., compliance points for X2) and the expected contribution toward reaching TMDL targets for a range of contaminants and stressors (e.g., boron, methylmercury, temperature).

7. Consider the relative protection afforded to all beneficial uses adopted in the 2006 Bay-Delta WQCP.

EPA reviewed available information that indicates a relative amount of protection for beneficial uses identified in the 2006 WQCP. Information sources for this review included the State Water Board 2010 Integrated CWA 303(d)/305(b) and the multiple sources referenced in EPA's 2012 Action Plan and 2011 Advance Notice of Proposed Rulemaking for Water Quality Challenges in the Bay Delta Estuary. This information is summarized in Table 1. We encourage the State Water Board to consider this information and build upon it when evaluating flow objectives in the update to the 2006 Bay-Delta WQCP and the goal of protecting all beneficial uses in the Bay Delta Estuary.

Table 1

Beneficial Use Category	***Beneficial Uses***	**Water Quality Impairments (303(d) Listed)**	**Other information**	**Relative Level of Protection**
Aquatic Life	*Cold freshwater Habitat* *Warm freshwater habitat* *Migration of aquatic organisms* *Spawning, reproduction, and early life stage* *Estuarine habitat*	• Legacy Pesticides • Current-use pesticides • Other organic compounds • Heavy metals • Low DO organic enrichment • Invasive	• Long term fish population declines • Recent rapid fish population declines • ESA jeopardy opinions • N:P & NH3/NH4 impact on plankton composition & abundance	**Inadequate**

	Rare, threatened or endangered species habitat	species • Trash • Unknown toxicity	Toxic blue-green algae impacts	
Wildlife	*Wildlife Habitat –supports estuarine ecosystems*	• Methylmercury • Trash • Selenium	• Toxic blue-green algae impacts	**Poor**
Food and recreational consumption of aquatic life	*Commercial and sport fishing* *Shellfish harvesting*	• Methylmercury • Legacy pesticides • Other organic compounds	• Closed salmon fishery 2008-09 • Limited salmon fishery 2010 • OEHHA fishery consumption limits • ESA jeopardy opinions • Toxic blue-green algae impacts • Major increase in largemouth bass fishery	**Inadequate**
Recreation	*Contact* *Non-contact*	• Pathogens	• Toxic blue-green algae impacts • Beach closure	**Good???**
Consumptive Use	*Municipal and domestic water supply* *Agricultural water supply* *Groundwater recharge* *Industrial Process* *Industrial Supply*	• Electrical conductivity (salt)	• CVP & SWP exports increasing • Disinfection by-products • Invasive species – *Egeria densa*	**Good**
Navigation	*Navigation*	None	None	**Good**

What changes to the Bay-Delta Plan should the State Water Board consider based on the above information?

1. ***Percent unimpaired flow objectives should be connected to essential fish habitat elements regardless of the potential, relative, difference between unimpaired flow and pre-development natural flows.***

Expressing flow objectives as percent unimpaired flow is valid if the resulting flows protect essential habitat elements such as salinity, temperature, nutrient loads, turbidity, and estuarine hydrodynamics, as well as the composition, abundance and distribution of food.

Some evidence suggests that unimpaired flow through the Delta would be greater today than it was in pre-settlement times when the Delta was characterized by vast wetlands and riparian forests [presentations by water contractors at Board's workshop of September 5, 2012]. EPA has not reviewed evidence supporting this idea but it is consistent with the change from considerably larger, pre-settlement aquatic habitat characterized by tidal marsh, freshwater wetland, floodplain, riparian forest and dendritic stream network to the present day system which has less than 10% of the historic floodplain and wetland habitat and a highly simplified, straightened, and armored stream network.

The idea that historic natural flows through the Delta were less than unimpaired flow through the present-day Delta could be used to argue that protecting fishery resources does not require increased freshwater flows through the Delta and that the State Water Board should instead focus on other stressors to reverse the decline of pelagic organisms and salmonids. However, this argument does not recognize the State Board is discussing a ***percent*** of unimpaired flow for flow objectives and there are now very limited choices for high quality aquatic habitat that support fisher resources as a direct result of the greatly diminished ecosystem functions of the present day Delta.

The State Board has proposed choosing a ***percent*** of unimpaired flow, not total unimpaired flow. The percent should be identified by ensuring that essential habitat elements (salinity gradient, turbidity, etc…) are protected in the modern-day Bay Delta Estuary.

The large-scale destruction of aquatic habitat in the Delta and Central Valley has left very few locations with high quality aquatic habitat to support fishery resources. The pre-settlement Delta absorbed, stored, and discharged large quantities of freshwater flows from the Sacramento and San Joaquin river basins on a year round basis. These freshwater flows moved slowly westward through complex wetland systems replete with dendritic channels and sloughs where habitat conditions were ideal for the reproduction and survival of pelagic fishes and salmonids. Freshwater transferred through seepage and transpiration served valuable ecosystem functions, e.g., recharging aquifers, providing a barrier to seawater intrusion, maintaining instream temperatures, and moderating the regional climate. More than 95% of the aquatic habitat that characterized the pre-settlement Delta and supported the survival of pelagic fishes and salmonids are now gone. There are high quality habitat elements in the Suisun complex (Suisun Marsh, Suisun Bay, Grizzly Bay, and Honker Bay). This location is downstream of the Delta. Protecting aquatic habitat to support aquatic life beneficial uses may require freshwater flows through the Delta that are greater than historic natural flows.

2. Identify a winter-spring Delta Outflow Objective by adjusting the current spring outflow criteria to better protect the spawning period.

    a. Begin the objective in January or a reliable measure of first flush turbidity that cues longfin smelt to begin spawning migration. This may mean that the objective begins in December.
    b. Require the Roe Island standard in and remove the Roe Island trigger.
    c. If the Board wishes to express this objective as a percent of unimpaired flow, we advocate that the Board connect the chosen percent unimpaired flow objective to the spring time salinity gradient and the correlative X2-abundance relationships that have been established, re-established, and supported over the last two decades.
    d. This objective could be constrained by identifying a threshold limit for changes to reservoir releases needed to support of other aquatic life and consumptive beneficial uses.
    e. This objective would require re-evaluation in the event of multiple simultaneous or rapid sequential levee collapses in the Delta.

3. Identify summer and fall Delta Outflow Objectives that improve LSZ quality and variability.
    a. Identify a summer/fall Delta Outflow objective (or range of objectives for evaluation) by adjusting the Fall X2 Delta Outflow criteria identified in the 2010 Flow Criteria Report subject to total reservoir storage at the end of June until the first wintertime storm.

    b. This adjustment should result in a Delta Outflow objective that is practical to achieve, provides protection for all beneficial uses, and supports the co-equal goals.

    Total reservoir storage is a measurable quantity and is directly related to preserving adequate carryover storage for all other uses of the reservoirs. To avoid conflict between reservoir storage needs and outflow needs, we suggest that outflow in these months be treated as a bypass flow requirement for all diversions. That is, diversions should only be allowed when required outflows, indexed to reservoir fullness, have been met. Such a restriction might encompass all diversions, a subset of diverters proportional to seniority of water rights, a subset of diverters proportional to size of diversion, or whatever other priorities the Board might establish in Phase III.

    The nature of the bypass flow requirement should be adequate to achieve baseline goals but flexible to unsure variability and to promote adaptive management. These requirements could be under the real-time guidance of an appointed group of scientists, engineers, and regulatory personnel, similar or identical to the groups used to manage implementation of the ESA Biological Opinions.

    Bypass flows in summer and fall should vary in timing and duration to achieve an enhanced level and a baseline level of protection of estuarine ecosystem conditions across all months and years. For instance, a rough first cut would be:

Reservoir fullness	Summer outflows	Fall outflows
Upper quartile	2 months X2<74, 84 otherwise	3 months X2<74
Second quartile	1 month X2 <74, 84 otherwise	1.5 months X2<74
Third quartile	X2 <84	X2<84
Lowest quartile	Ad lib	Ad lib

4. Sacramento Inflows
   a. Rio Vista
   b. Floodplain flows?

5. Net Old and Middle River Flow Objectives
   a. E/I Ratio
   b. Jersey Point

6. San Joaquin Inflows -- Vernalis

What is the level of scientific certainty or uncertainty regarding the foregoing information?

From a historical perspective, decisions to dramatically alter and transform the Bay Delta ecosystem were made without an understanding or appreciation of the ecosystem services provided by an intact system. Since the advent of the State Porter-Cologne Act (1969) and the federal Clean Water Act (1972), greater attention has been paid to the potential impacts our actions will have on the quality and sustainability of beneficial uses within the Bay Delta Estuary, but much of the most severe environmental damage was already done. Each day, agencies at the federal, State, and local level continue to make decisions affecting the Bay Delta Estuary, and these decisions are made in the same atmosphere of uncertainty faced by the State Water Board.

The Bay Delta is the most studied estuary in the world. We understand more than ever about its physical, chemical, and biological processes. Nevertheless, each new finding brings new questions and uncertainties – such is the course of scientific inquiry. These questions are becoming more vexing as we try to understand a Bay Delta that may be undergoing an ecological regime shift. Rather than using uncertainty as a reason for maintaining the status quo, EPA recommends that the State Water Board embrace the questions and uncertainties and use the precautionary principle to prevent irreversible damage to the ecosystem, and to take measured actions likely to produce favorable outcomes that lead to more sustainable management of the Bay Delta.[7]

[7] Farber, R., Costanza, R., Childers, D.L., Erickson, J., Gross, K., Grove, M., Hopkinson, C.S., Kahn, J., Pincetl, S., Troy, A., Warren, P., and Wilson, M. 2006. Linking Ecology and Economics for Ecosystem Management. BioScience. http://www.bioone.org/doi/full/10.1641/0006-3568(2006)056%5B0121%3ALEAEFE%5D2.0.CO%3B2

What changes to the Bay-Delta Plan should the State Water Board consider to address existing circumstances and changing circumstances such as climate change and BDCP?

Decisive action by the State Water Board to set meaningful Delta outflow standards is the most important step the Board can take toward implementing the Bay-Delta Plan and formulating a sound and defensible BDCP. Adaptive management is already built into the triennial review process for setting, implementing, and monitoring the effects of water quality standards. Therefore, EPA recommends that the State Water Board take action now based on the wealth of available scientific information, and set in motion a credible process for adjusting standards for an uncertain future.

How should the State Water Board address scientific uncertainty and changing circumstances including climate change, invasive species and other issues? Specifically, what kind of adaptive management and collaboration (short, medium, and long-term), monitoring, and special studies programs should the State Water Board consider related to Bay-Delta fisheries as part of this update to the Bay-Delta Plan?

Invited panel offer to develop modeling and adaptive response to specified future change, UMARP, and delta RMP

[content needed, Tim ran out of time and ideas]

Thank you for this opportunity to provide written comments. EPA looks forward to the upcoming workshops. If you have any questions about our comments or about the material attached, please contact me at (415) 972-3472.

Very truly yours,

Original signed by

Karen Schwinn
Associate Director
Water Division